Identifying Contributors to Changes in Attrition

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ABSTRACT

The overall attrition rates for the Canadian Forces (CF) were 6.8% in Fiscal Year (FY) 05/06, 8.3% in FY 06/07 and 9.0% in FY 07/08. What caused the difference: a demographic change or an attrition behaviour change? A methodology was developed and an analysis was conducted to answer this question.

The first step is to identify the major contributors by quantifying demographic and behaviour effects on the observed change in attrition rate. In order to do this, attrition forecasts need to be calculated. Existing research shows CF attrition is strongly related to members' Years of Service (YOS) profile. Attrition forecasts therefore were performed based on a Weighted Average YOS-based attrition forecasting methodology. The second step is a further decomposition process to identify the YOS groups that contribute the most, and quantify the contribution down to each YOS level.

Applying the developed techniques on CF attrition revealed that the increased CF attrition rate in FY 07/08 was primarily due to changes in attrition behaviour. The further decomposition of the behaviour effect identified three primary contributing YOS groups, specifically those personnel with 0 YOS (i.e. in their first year of service), 3 YOS and 1 YOS, in the order of their contribution. Thus it was the attrition behaviour changes of those personnel in the early stages of their career that contributed to the rise in the overall attrition rate. Applying the techniques on CF attrition from FY 00/01 to FY 06/07 showed two additional significant changes in CF attrition. These changes were also mostly due to attrition behaviour changes. Further decomposition of the contributions at the YOS level revealed the possible impacts of significant policy/strategy changes, such as salary increases and changes in the personnel selection process.

This research provides a quantification of demographic and behaviour impacts on attrition changes. The further decomposition at each YOS level identifies the primary contributing YOS groups to changes in attrition. This methodology and analysis can improve understanding of what drives changes in the overall attrition rates, thereby supporting the development of targeted retention initiatives.

1.0 BACKGROUND

Transforming and modernizing the Canadian Forces (CF) started in 2005. CF Transformation focuses on people, technology, ways of conducting operations and ways of thinking. Since people are a key element to the CF transformation, it is clear that CF personnel management plays an important role in this

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14. ABSTRACT
The overall attrition rates for the Canadian Forces (CF) were 6.8% in Fiscal Year (FY) 05/06, 8.3% in FY 06/07 and 9.0% in FY 07/08. What caused the difference: a demographic change or an attrition behaviour change? A methodology was developed and an analysis was conducted to answer this question. The first step is to identify the major contributors by quantifying demographic and behaviour effects on the observed change in attrition rate. In order to do this, attrition forecasts need to be calculated. Existing research shows CF attrition is strongly related to members Years of Service (YOS) profile. Attrition forecasts therefore were performed based on a Weighted Average YOS-based attrition forecasting methodology. The second step is a further decomposition process to identify the YOS groups that contribute the most, and quantify the contribution down to each YOS level. Applying the developed techniques on CF attrition revealed that the increased CF attrition rate in FY 07/08 was primarily due to changes in attrition behaviour. The further decomposition of the behaviour effect identified three primary contributing YOS groups, specifically those personnel with 0 YOS (i.e. in their first year of service), 3 YOS and 1 YOS, in the order of their contribution. Thus it was the attrition behaviour changes of those personnel in the early stages of their career that contributed to the rise in the overall attrition rate. Applying the techniques on CF attrition from FY 00/01 to FY 06/07 showed two additional significant changes in CF attrition. These changes were also mostly due to attrition behaviour changes. Further decomposition of the contributions at the YOS level revealed the possible impacts of significant policy/strategy changes, such as salary increases and changes in the personnel selection process

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transformation. Knowledge about attrition is crucial to CF personnel management, e.g., to properly plan the recruitment, training, and promotion of the military force members. Indeed, attrition has become a spotlighted issue in recent years because the CF had experienced a continually increasing attrition rate[1] from Fiscal Year (FY) 01/02 to FY 07/08. Over that time, the attrition rate rose significantly, from 6.0% to 9.0%.

Attrition can be influenced by many factors, such as occupation, economic factors, policies, and so on. In particular, attrition in the CF is strongly related to Years of Service (YOS) because most attrition occurs at or shortly after exit gates between engagements, and most engagements have a prescribed duration measured in YOS. The blue line in Figure 1 shows the historical attrition rate at each YOS. This is a typical attrition pattern for the CF. A briefing to the Canadian National Retention Group Meeting in Nov 2007 [1] showed that there are two major contributors to changes in attrition: a behaviour effect (i.e., caused by changes in attrition behaviour, at some or all YOS) and a population demographic effect (i.e., caused by changes in the population years of service profile). The CF population profile is shown as the red bars in Figure 1.
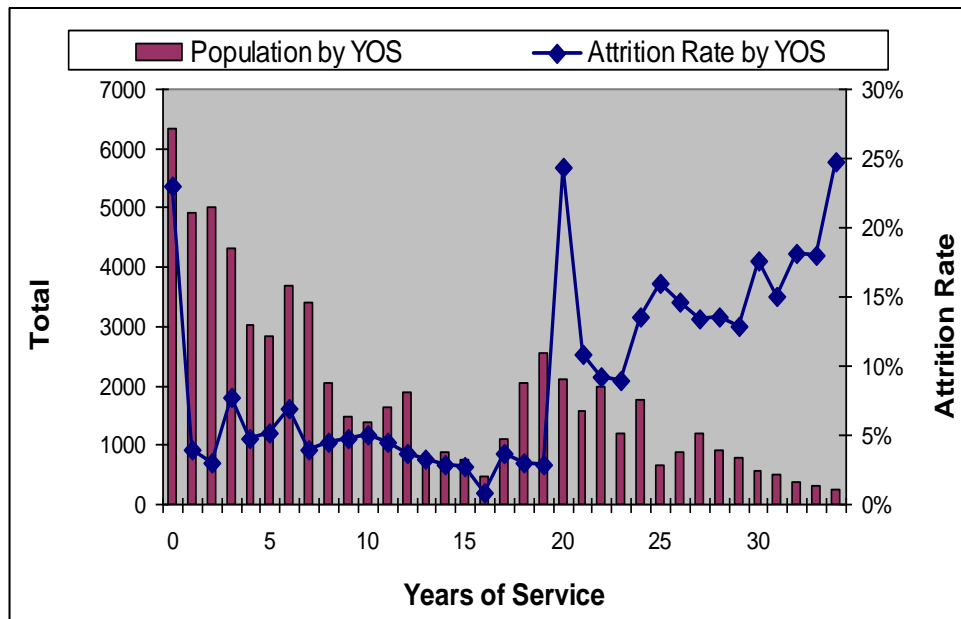

Figure 1: Canadian Forces Attrition and Population Profile by YOS

Recent attrition analyses showed that the overall attrition rates for CF personnel were 6.84% in FY 05/06, 8.32% in FY 06/07 and 8.95% in FY 07/08. What caused the difference? Which contributes the most: a change in the demographic profile or an attrition behaviour change? Quantifying the contributions of these two factors can reveal what drives attrition changes, thereby supporting the development of targeted retention initiatives.

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[1] This research study examined CF attrition from FY 00/01 to FY 07/08. In FY 09/10, the CF experienced a drop in attrition rate, which may be due to the recent economic recession. This recent decrease will be investigated using the same techniques discussed in this paper. In this paper, CF represents the Regular Force component of the CF.

2.0 METHODOLOGY

The three attrition rates/volumes used to quantify demographic and behaviour effects on attrition change are:

- Actual annual attrition rate/volume: α/A

- Annual attrition rate/volume assuming there is no demographic nor behaviour change: α1/A1

- Annual attrition rate/volume assuming there is no behaviour change: α2/A2

Bender 2007 [1] proposed a new idea on the quantification of the demographic and behaviour effects. The detailed calculation has been developed and modified from the original calculation. In the following, *RD* represents relative demographic effect:

$$RD = \frac{\alpha 2 - \alpha 1}{\alpha} \tag{1}$$

while *RB* represents relative behaviour effect.

$$RB = \frac{\alpha - \alpha 2}{\alpha} \tag{2}$$

Formula (3), which is from Okazawa 2007 [2], shows the Canadian calculation[2] of the overall yearly attrition rate for the CF. This attrition rate calculation considers both the population at the beginning of the year, P_0, and the number of new recruits for the whole year, *R*. The reason why *R* is considered as a half is because it is assumed that recruits arrive gradually over the course of the year and are only present to suffer attrition for what remained of the year.

$$\alpha = \frac{A}{P_0 + 0.5R} \tag{3}$$

Similarly,

$$\alpha 1 = \frac{A1}{P_0 + 0.5R} \tag{4}$$

$$\alpha 2 = \frac{A2}{P_0 + 0.5R} \tag{5}$$

By replacing *α1*, *α2* and *α* in equations (1) and (2) with equations (3), (4) and (5), the relative demographic and behaviour effects (*RD* and *RB*) can be calculated as follows:

$$RD = \frac{A2 - A1}{A} \tag{6}$$

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[2] There are several different methods of calculating attrition rates (propensity-to-leave) in the defence research community. According to the material circulated during The Technical Cooperation Program (TTCP) Workforce Modelling and Analysis Working Group meeting that was held in Ottawa in 2008, each of the nations represented (Australia, New Zealand, Canada and United Kingdom) calculated attrition somewhat differently.

$$RB = \frac{A - A2}{A} \tag{7}$$

Quantifying the relative demographic effect, *RD,* and the relative behaviour effect, *RB*, would be performed after the entire year has elapsed and data collection is complete, at which time, not only the stating population, P_0, but also the actual attrition volume, *A,* and number of recruits, *R,* are available. Forecasting attrition assuming no attrition behaviour changes, *A2,* has been extensively investigated within Director General Military Personnel Research and Analysis (DGMPRA). These forecasts are performed based on a refined Weighted Average YOS-based attrition forecasting methodology documented in Fang et al. 2009 [3]. The following paragraphs describe the procedures for calculating *A1,* the forecasted attrition volume assuming no demographic and no behaviour changes. This would be the last factor needed to quantify the relative behaviour effect, *RB,* and the relative demographic effect, *RD*.

Table 1 lists the acronyms used in the following paragraphs describing the procedures for calculating *A1*.

Table 1: Acronyms Used in the Procedures for Calculating *A1*

α_m	Attrition rate at *m* YOS
$A_m[n]$	Attrition volume for year *n-1*, for members with *m* YOS where YOS is measured at the beginning of year *n*
$A[n]$	Total attrition volume for year *n-1*, for all YOS
m	*m* YOS
$P_m[n-1]$	Population with *m* YOS at the beginning of year *n-1*
$P[n-1]$	Total population at the beginning of year *n-1*
$P_m[n]$	Population at *m* YOS at the beginning of year *n*
$P[n]$	Total population at the beginning of year *n*
RB	Relative behaviour effect
RD	Relative demographic effect
$T[n]$	Net transfers (including both recruitment and transfers) in year *n-1*
$T_m[n]$	Net transfers (including both recruitment and transfers) in year *n-1*, for members with *m* YOS, where YOS is measured at the beginning of year *n*
$T[n+1]$	Net transfers (including both recruitment and transfers) for year *n*

As shown in Equation (8), the total attrition volume for year *n* is the sum of the attrition volumes at all YOS, *m*.

$$A[n] = \sum_m A_m[n] \tag{8}$$

The following formulae (from Reference [3]) are used for forecasting attrition $A_m[n]$:

For *m>0*,

$$A_m[n] = \alpha_m \times \left(\frac{1}{2} P_{m-1}[n-1] + \frac{1}{2} P_m[n-1] + \frac{1}{3} T_m[n] + \frac{1}{6} T_{m+1}[n] \right) \tag{9}$$

And for *m=0*,

$$A_0[n] = \alpha_0 \times \left(\frac{1}{2} P_0[n-1] + \frac{1}{2} T_0[n] + \frac{1}{6} T_1[n] \right) \tag{10}$$

where, for analyses at the CF level, T represents the number of recruits. For analyses at a lower level, e.g. at a military occupation level, T will include not only recruits but also net transfers, e.g. net volume of transfers into the occupation from other occupations.

Letting,

$$P'_m[n-1] = \frac{1}{2}P_{m-1}[n-1] + \frac{1}{2}P_m[n-1] + \frac{1}{3}T_m[n] + \frac{1}{6}T_{m+1}[n] \tag{11}$$

and

$$P'_0[n-1] = \frac{1}{2}P_0[n-1] + \frac{1}{2}T_0[n] + \frac{1}{6}T_1[n] \tag{12}$$

then,

$$A_m[n] = \alpha_m \times P'_m[n-1] \tag{13}$$

and

$$A_0[n] = \alpha_0 \times P'_0[n-1] \tag{14}$$

where $P'_m[n-1]$ and $P'_0[n-1]$ can be simply considered as the corresponding population in year n-1 which contributes to the m or 0 YOS attrition, respectively. Simply speaking, the attrition volume at m YOS is the product of the attrition rate at m YOS and the corresponding population associated with m YOS attrition.

Now, in order to calculate $A1$ for year n (the forecasted attrition volume assuming neither demographic nor behaviour change), the corresponding population profile assuming no demographic change needs to be determined for year n. If $P'_m[n-1]$ represents the corresponding population for year n-1 associated with m YOS attrition, then let $P''_m[n]$ represent the assumed corresponding population in year n associated with m YOS attrition *if there were no demographic change*. In other words, no demographic change means that the proportion of the population at each YOS is kept the same as that from the previous year.

Because the CF population is dynamic and varies year by year, in order to obtain a population profile assuming no demographic change from the previous year, and to keep the sum of $P''_m[n]$ equal to the total population of year n, the corresponding population at each YOS assuming no demographic change, $P''_m[n]$, should be normalized as follows:

$$P''_m[n] = P'_m[n-1] \times \frac{Total\ Population\ for\ Year\ n}{Total\ Population\ for\ Year\ n-1} \tag{15}$$

Again, due to the dynamic population size, the CF population can be approximated as follows:

$$Total\ Population\ for\ Year\ n = P[n] + 0.5T[n+1] \tag{16}$$

$$Total\ Population\ for\ Year\ n-1 = P[n-1] + 0.5T[n] \tag{17}$$

Therefore,

$$P_m''[n] = P_m'[n-1] \times \frac{P[n] + 0.5T[n+1]}{P[n-1] + 0.5T[n]}$$

(18)

The benefit of this scaling is that it considers not only the demographic profile of the population at the beginning of the year but also the demographic profile of the net transfers during the year (including recruits). The reason only half of the net transfers in $T[n+1]$ and $T[n]$ are considered is because it is assumed not only the new recruits but also the transfers arrive gradually over the course of the whole year and are only present to suffer attrition for what remained of the year.

The attrition volumes at each YOS level assuming neither a demographic nor a behaviour change, $A1_m[n]$, are calculated using the following Equation:

$$A1_m[n+1] = \alpha_m \times P_m''[n]$$

(19)

$A1$ for year n can then be obtained by the summing $A1_m[n]$ for each m YOS using Equation (8). Then the relative demographic effect (*RD*) and the relative behaviour effect (*RB*) can be quantified using Equations (6) and (7) along with this calculated value for $A1$, the calculated attrition volume assuming no attrition behaviour change, *A2*, and the actual attrition volume *A*.

3.0 FINDINGS

3.1 At Overall Level

Applying the developed technique to the CF attrition data from FY 00/01 to FY 07/08 revealed the following insights:

1. During the period from FY 00/01 to FY 07/08, three changes in attrition warranted further exploration.

   • The significant attrition rate decrease from 6.9% in FY 00/01 to 6.0% in FY 01/02;

   • The significant attrition rate increase from 6.8% in FY 05/06 to 8.3% in FY 06/07; and

   • The significant attrition rate increase from 8.3% in FY 06/07 to 9.0% in FY 07/08.

2. The decrease of attrition rate in FY 01/02 and the increase in FYs 06/07 and 07/08 were due to changes in attrition behaviour. The relative demographic and behaviour effects were quantified for these significant changes in attrition rates. The relative demographic and behaviour effects were 2.8% and -17.3% respectively, for the decrease from FY 00/01 to FY 01/02[3], -1.2% and 18.9% for the increase from FY 05/06 to FY 06/07, and 7.26%, and -0.14% for the increase from FY 06/07 to FY 07/08.

Figure 2 plots the three attrition volumes – actual, *A*, forecast if there were no behaviour change, *A2*, and forecast if there were neither a demographic nor behavioural change, *A1* – that were calculated for the analyses of the significant change in attrition rate that occurred between FY 06/07 and FY 07/08. Generally speaking, from an absolute difference point of view, these three attrition volumes are similar except at the 0 YOS point.

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[3] A positive relative effect means that the change in the demographic profile or attrition behaviour caused an increase in the attrition; and a negative relative effect means that the change in the demographic profile or attrition behaviour caused a decrease in attrition. The greater the absolute value, the greater the effect. For example, the relative behaviour effect of -17.3% from FY 00/01 to FY 01/02 means the attrition decrease during that period was due to a behaviour change, and the positive RD value of 2.8% means that the observed attrition rate decrease was moderated slightly by a change in the demographic profile.
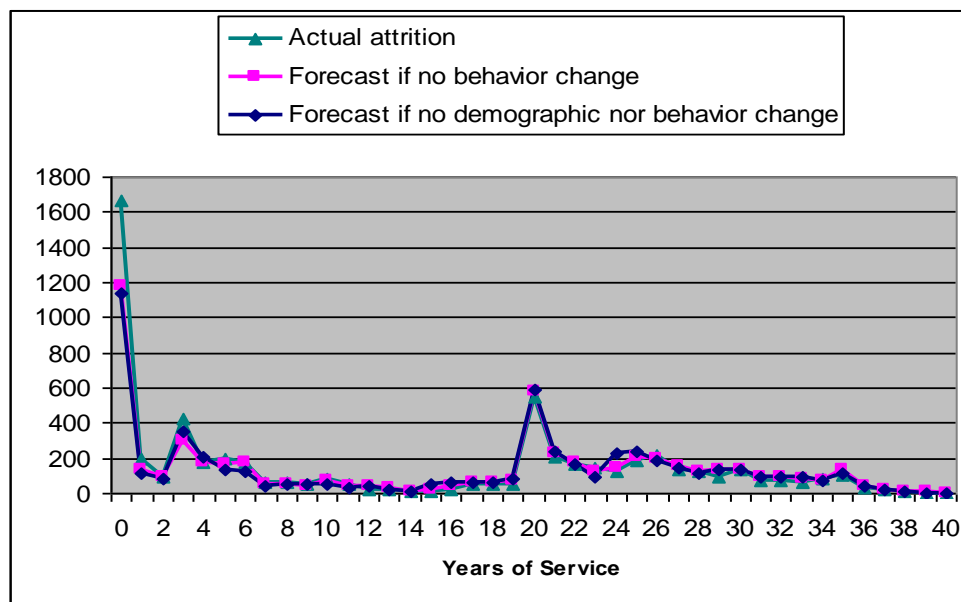
Figure 2: CF Actual and Forecasted Attrition for FY 07/08

Table 2 provides the three attrition volumes, *A1, A2, A* and the relative demographic and behaviour effects for FY 07/08. These values show that at the overall level, the increase of attrition from 8.3% in FY 06/07 to 9.0 % in FY 07/08 is the result of a behaviour effect. The positive *RB* (*RB*=7.26%) means the behaviour change in FY 07/08 increased the overall attrition rate, while the much smaller negative *RD* (-0.14%) means the demographic change in FY 07/08 slightly decreased the attrition rate, thereby moderating the total observed increase in the attrition rate.

Table 2: Three Attrition Volumes and Demographic and Behaviour Effects for FY 07/08.

A1 (attrition volume if no demographic and behaviour change)	5578
A2 (attrition volume if no behaviour change)	5569
A (actual attrition volume)	6005
RD (Relative demographic effect)	-0.14%
RB (Relative behaviour effect)	7.26%

3.2 Decomposition at the YOS Level

The decomposition of the attrition behaviour effect (*RB*) at each YOS revealed that the three YOS groups that contributed the most to the attrition rate decrease in FY 01/02 were 21, 3 and 20 YOS (in order of contribution). For FY 06/07, the three YOS groups that contributed the most were 0, 20 and 24 YOS, and for FY 07/08, they were the 0, 3 and 1 YOS groups.

The analysis of overall attrition changes and their further decomposition to the YOS level, as was done above, can assist in finding policy changes which may have had an impact on attrition. The following are possible explanations for the above changes in attrition behaviour:

1. Personnel Selection Process Changes: In 2006, changes were made in the personnel selection process, e.g. waiving the fitness test to accelerate the recruiting process. Attrition increases were observed in both FYs 06/07 and 07/08 and the 0 YOS group was the greatest contributor to both these increases. The most likely reason for this would be the changes to the personnel selection process. (Particular attention to, and analysis of, attrition during the early stages members' careers is ongoing, with the objective of increasing retention of these personnel.)

2. Pay Increases: As a result of the 2000 annual report to the Standing Committee on National Defence and Veterans Affairs (SCONDVA), the CF introduced substantial pay increases and other quality of life improvements for CF members. It is possible that because of these substantial pay increases, CF members who were close to the 20 YOS point and thereby eligible for (or almost eligible for) an unreduced pension[4] may have chosen to defer their release in order to increase their pension, which is based on the average of the five best years of salary. Therefore it was not surprising that 21 and 20 YOS groups were the greatest contributors to the overall decrease in attrition in FY 01/02. Five years later, in FY 06/07, attrition increased significantly, again due to a behaviour effect. Two of the three largest contributing groups were the 20 and 24 YOS groups. Because members with pensionable service would have been able to take full advantage of the raises in salary to increase their pensions by that time, increased attrition for these groups starting in FY 06/07 is understandable. The other major contributor to the decreased attrition in FY 01/02 was the 3 YOS group, which is typically the point at which the first engagement period for Non-Commissioned Members[5] is coming to an end. At this point, members will have either signed up for another engagement or decided to release from the CF. The decreased attrition with 3 YOS in FY 01/02 year may be also the result of the pay and quality of life improvements that began in that time period.

4.0   CONCLUSIONS

The methodology described provides a way to quantify the impact of demographics and of attrition behaviour on changes to the CF attrition and to identify the major contributor (attrition behaviour effect or demographic profile effect) to a specific attrition change. The further decomposition at each YOS level identifies the primary YOS groups which contribute most to these changes in attrition, thereby assisting in discerning which policy changes may have influenced attrition.

Applying the above technique to the CF data from FY 00/01 to FY 07/08 revealed that attrition behaviour changes, not demographic changes caused the three significant attrition rate changes that occurred during this period. These analyses also provided some insights regarding the likely policy/strategy changes, i.e., salary increases and changes in the personnel selection process, that affected the attrition behaviour of CF military members.

Transformation is built on many lessons learned. This paper provides a tool to identify contributors to changes in attrition. The findings from analyses of this type can improve the understanding of what has driven the observed changes in the overall attrition rates, identify future research areas, and these lessons can then be used to support the development of targeted retention initiatives.

REFERENCES

[1]   Paul Bender. (2007*) Attrition Analysis.* Presentation to the National Retention Team Working Group, November 2007.

[2]   Stephen Okazawa. (2007). *Measuring Attrition Rates and Forecasting Attrition Volume.* Defence Research and Development Canada Centre for Operational Research and Analysis Technical Memorandum 2007-02.

[3]   Manchun Fang, Stephen Okazawa. (2009). *Forecasting Attrition Volume: a Methodological Development*. Director General Military Personnel Research and Analysis Technical Memorandum 2009-25.

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[4] Under the previous CF Terms of Service, members who served under the Indeterminate Engagement 20 (IE20) and releasing with 20 YOS could collect their pension without penalty.

[5] The first engagement period for non-commissioned members (NCMs) was three years up until new Terms of Service were introduced in January 2005, at which time some NCMs were enrolled with engagement periods that typically range from three to five years. Relatively more releases occur at the end of engagement periods.